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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/823,371	04/12/2004	Steven C. Shannon	8824/ETCH/DRIE	4850

55649 7590 10/01/2010

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ART UNIT	PAPER NUMBER
1716	

NOTIFICATION DATE	DELIVERY MODE
10/01/2010	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte STEVEN C. SHANNON and JOHN HOLLAND

Appeal 2009-005698
Application 10/823,371
Technology Center 1700

Before EDWARD C. KIMLIN, ADRIENE LEPIANE HANLON, and PETER F. KRATZ, *Administrative Patent Judges*.

KRATZ, *Administrative Patent Judge*.

DECISION ON APPEAL[1]

This is a decision on an appeal under 35 U.S.C. § 134 from the Examiner's final rejection of claims 1, 3-10, and 12-21. We have jurisdiction pursuant to 35 U.S.C. § 6(b).

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, or for filing a request for rehearing, as recited in 37 C.F.R. § 41.52, begins to run from the "MAIL DATE" (paper delivery mode) or the "NOTIFICATION DATE" (electronic delivery mode) shown on the PTOL-90A cover letter attached to this decision.

Appellants' claimed invention is directed to an apparatus for matching the impedance of each of a pair of independent RF sources coupled to a single powered electrode, via a common output terminal, to the impedance of plasma in a semiconductor substrate processing chamber (Spec., paras. 0002, 0013, and 0025). The matching circuit (dual frequency match element) of the apparatus comprises first and second sub-circuits having a common output coupled to the electrode and wherein a match-tune space defined by a first sub-circuit can be varied without affecting a second match tune space defined by the second sub-circuit (claim 1). Figure 3A graphically depicts tune space shift for a circuit design of the present invention as identified in the Specification, wherein the frequency tune space of a sub-circuit coupled to one RF source does not shift when the match tune space of another sub-circuit coupled to the other RF source is varied by shunt component tuning (Spec. paras. 0020-0021; Fig. 3A).

Claims 1 and 21 are illustrative and reproduced below:

1. Apparatus for matching the impedance of a pair of RF sources coupled to a single electrode to the impedance of a plasma in a semiconductor substrate processing chamber, comprising:

a first sub-circuit for matching the impedance of a first variable frequency RF signal generated by a first RF source to the impedance of the plasma; and

a second sub-circuit for matching the impedance of a second variable frequency RF signal generated by a second RF source to the impedance of the plasma, the second sub-circuit connected to the first sub-circuit to form a common output that is coupled to the electrode;

wherein the first and second sub-circuits each further comprise at least one fixed set of series components and at least one variable shunt component connected to ground, and wherein a first match tune space

defined by the first sub-circuit can be varied without affecting a second match tune space defined by the second sub-circuit.

21. Apparatus for matching the impedance of a pair of RF sources coupled to a single electrode to the impedance of a plasma in a semiconductor substrate processing chamber, comprising:

a first sub-circuit for matching the impedance of a first RF signal generated by a first RF source to the impedance of the plasma; and

a second sub-circuit for matching the impedance of a second RF signal generated by a second RF source to the impedance of the plasma, the second sub-circuit connected to the first sub-circuit to form a common output that is coupled to the electrode;

wherein the first and second sub-circuits are each adapted to vary a respective match tune space defined by the respective sub-circuit without affecting another respective match tune space defined by the other sub-circuit.

The Examiner relies on the following prior art reference as evidence in rejecting the appealed claims:

Nishiyama	JP 08-097199A	Apr. 12, 1996
Deguchi	JP 06-243992A	Sep. 2, 1994
Goodman	6,887,339 B1	May 3, 2005
Suemasa	6,641,149 B2	Nov. 4, 2003

The Examiner maintains the following grounds of rejection as the only rejections before us for review:

Claims 1, 3, 4, 6, 7, 9, 10, 12-15, and 17-21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi. Claim 5 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi, and Goodman. Claims 8 and 16 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi, and Suemasa.

We reverse.

Nishiyama discloses an apparatus including two variable frequency RF power sources, each connected to a plasma chamber electrode via matching networks (Fig. 1; para. 0012).

Deguchi discloses an RF power supply for an electrode of a plasma processing device including an impedance matching section (para. 0010). In the matching section, a difference between the impedance on the RF power supply side and an input impedance on the electrode negative charge side is detected and a variable transmission frequency of the RF power supply and the capacitance of a variable capacitor in the matching section are controlled to affect the desired impedance matching (paras. 0010-0017, and 0020). Deguchi discloses the matching section can include a variable capacitor 22 and fixed components, such as a blocking capacitor 28 (para. 0016; Figs. 1 and 2).

Concerning the first stated rejection, the Examiner maintains that:

> It would have been obvious to one of ordinary skill in the art to modify each of the first and second matching sub-circuits for variable frequency RF sources 16, 17 taught by Nishiyama et al. to each comprise a matching sub-circuit having a fixed set of series components and a variable shunt capacitor, as taught by Deguchi et al. The motivation for making such a modification to each sub-circuit, as taught by Deguchi et al. (Paragraphs 11, 19, 20, 30, and 31), would have been that the combination of such a matching sub-circuit with a variable frequency RF source allows the impedance of the RF signal to be matched to the impedance of the plasma quickly with fewer variable capacitors and overall smaller equipment size by varying the frequency of the RF signal generated by the RF source and by varying the shunt capacitance.
>
> Further in regards to Claims 1, 3, 9, 10, 12, and 19-21, the apparatus taught by the combination of Nishiyama et al. and

> Deguchi et al. meets all of the structural limitations of the claimed invention, and would be structurally capable of performing the intended use of allowing the first match tune space defined by the first sub-circuit to be varied without substantially affecting the second match tune space defined by the second sub-circuit, by varying the variable shunt capacitors. (The Examiner refers to Paragraphs 20 and 21 of the instant Specification, which disclose that this intended use is performed in the manner just described as capable of being performed by the apparatus taught by the combination of Nishiyama et al. and Deguchi et al.)

Ans. 5.

In this regard, the Examiner seemingly takes the position that structural elements can be functionally defined; but, notes that if the prior art structure is capable of performing the claimed function than the claimed function is no more than an intended use as the prior art structure meets the claimed structure (Ans. 9).

Appellants have presented evidence in the form of a Declaration under 37 C.F.R. § 1.132 by Steven C. Shannon, one of the named inventors of the subject Application (App. Br., Evid. Appdx.).

Mr. Shannon states that:

> Other configurations of match circuit designs for coupling two frequencies to a common electrode and having at least one fixed set of series components and at least one variable shunt component connected to ground may be designed that do not provide a first match tune space that can be varied without affecting a second match tune space. Therefore, fixed series elements in the respective tuning portions of the dual frequency match circuit do not necessarily provide respective tune space independence.

Decl., para. 9.

The principal issue before us is:

Has the Examiner established that the dual RF power source apparatus of Nishiyama, if modified as generally proposed by the Examiner so that each matching network for the dual power supply comprises a circuit including a variable shunt capacitor connected to ground and a fixed set of series components as alleged to be taught by Deguchi for matching impedances in a single RF power supplied plasma chamber electrode, would necessarily result in a dual RF power supply system having matching sub-circuits that provide a tune space defined by one of the circuits (sub-circuit) that would have been capable of being varied without affecting the match tune space of the other modified circuit (sub-circuit)?

On this record, we answer this question in the negative and we reverse the stated rejections.

Concerning the first stated rejection over the proposed combination of Nishiyama and Deguchi, the Examiner argues that:

> The declaration is silent as to why the apparatus of the combination of Nishiyama et al. and Deguchi et al. would not be structurally capable of exhibiting the respective tune space independence of the claimed invention.
>
> Put another way, Examiner remains unable to identify any structural differences between the combination of Nishiyama and Deguchi (or the tested deficient match circuitry cited in the declaration) and the claimed or disclosed invention that would prevent the structural capability of Nishiyama and Deguchi to perform the same functions as the claimed or disclosed invention. The claimed combination of Nishiyama and Deguchi teaches all of the structural limitations of the claimed invention, and therefore must be capable of performing the same functions to reach the same outcome. Applicant argues that the functional recitations of the claims impose further structural limitations to the claimed invention that the combination of Nishiyama and Deguchi do not teach. But if this were the case, what further structural limitations could those

> be? There are no additional structural components claimed or disclosed by Applicant that Examiner could identify as contributing to the claimed function. What is it that gives the ability to independently control the first and second tune spaces if not the variable shunt elements and variable RF sources, which are taught in the combination of Nishiyama and Deguchi? What is the difference between the inventive and non-inventive match circuits tested in the declaration that causes them to perform differently? Examiner remains unable to answer these questions in any way that would point to the *nonobviousness* of the claimed invention. Examiner must conclude that the combination of Nishiyama and Deguchi, by teaching all of the structural limitations of the claimed invention, must be structurally capable of performing the same function.

Ans. 12-13.

However, it is the Examiner who has the burden of explaining how the Examiner is applying the combined teachings of the applied Nishiyama and Deguchi patent documents based on the record before us so as to necessarily result in the use of specific matching sub-circuits in Nishiyama that provide structure capable of performing the claimed matching function for one sub-circuit without affecting the match tune space of the other circuit, as claimed.[2] An inherent characteristic must be inevitable, and not merely a possibility or probability. *See In re Oelrich*, 666 F.2d 578, 581 (CCPA 1981).

Here, the Examiner has not carried the burden in the face of the Declaration evidence and corresponding argument presented by Appellants

[2] All of the rejections maintained by the Examiner are premised on this inherency theory. Concerning the Examiner's assertions regarding a lack of understanding of the nature of the structure required by the claimed functionality, we note that the only rejections before us are under 35 U.S.C. § 103(a).

of providing enough information to reasonably establish that the claimed functionally defined structure would have been necessarily achieved by implementing the Examiner's generally proposed combination of using a variable shunt capacitor and fixed components in each sub-circuit (match network) of Nishiyama. In this regard, the Examiner has not presented information that directly contradicts the Declarant's testimony to the effect that such general structure does not necessarily result in apparatus having the claimed functionality (Decl. para. 9).

Consistent with the Declarant's testimony, Appellants argue that different combinations of resistors, inductors, capacitors, etc., or similar arrangements of these elements having different values associated with each element, result in match circuits that are structurally different and that would possess differing capabilities (Reply Br. 6-7).

The Examiner does not base the tendered rejection on any argued suggestion or teachings that would have arguably led one of ordinary skill in the art to modify the circuits of Nishiyama in a manner appropriate to achieve a specific structure having the claimed functionality. Rather, the Examiner hinges the proposed rejection on the advocated inherency theory arguing that the claimed circuit including the claimed functionality would necessarily result upon generally using a variable capacitor shunted to ground and fixed series components in each of the match networks of Nishiyama.

As noted above and in the Appeal Briefs, however, Appellants have presented non-rebutted testimony indicating that the Examiner's argued inherency position is flawed because structure possessing the claimed functionality would not necessarily result upon implementation of the Examiner's generally proposed modification of Nishiyama.

For example, Appellants disclose for one embodiment that Appellants' match circuit can have a dual L-type match topography wherein each of the impedance matching sub-circuits (202 and 204) includes a variable capacitor shunting to ground (C_1 and C_4, respectively), an inductor (L_1,and L_2, respectively), and another capacitor (C_2 and C_3, respectively) (Spec. paras. 0016 and 0017; Fig. 2). The match circuit further includes an isolation sub-circuit (206) that is tuned to block a low frequency signal from one of the RF sources from being coupled to the other higher frequency RF source (Spec., para. 0018). In sub-circuit 202 of the one embodiment, the variable capacitor C_1 (300 pF -1500 pF) shunts across the input terminals from a $2MH_Z$ source, and the inductor L_1 (about 30 μH) and the capacitor C_2 (300 pF) are connected in series with the same input terminals and the common output terminal (Spec., para. 0017). In the second sub-circuit of the one embodiment, the variable capacitor C_4 (400 pF -1200 pF) shunts across the input terminals coming from the isolation sub-circuit (206), which is connected to a $13MH_Z$ source, and the inductor L_2 (about 2.4μH) and the capacitor C_3 (about 67 pF) are connected in series with the same input terminals and the common output terminal (Spec., paras. 0017-0019). Further details of the isolation sub-circuit in the one embodiment are provided in the Specification (Spec. paras. 0017-0018).

The Examiner has not shown that the combined teaching of Nishiyama and Deguchi would have necessarily led to a combination of sub-circuits having specific components as disclosed by Appellants, including substantially the same component values, and arranged as specifically disclosed in Appellants' Specification. Nor has the Examiner shown that the proposed combination of applied prior art would have necessarily resulted in any other specific combination of sub-circuits having particularly specified

components that have been demonstrated to possess the claimed functionality, such as by graphing such via a Smith chart (Decl., Exhibit A; Spec. Fig. 3A), and hence would have been expected to have structure corresponding to the claimed functionally defined structure so as to refute the Declaration testimony. The Examiner has not otherwise explained why it would have been within the skill level and interest (motivation) for one of ordinary skill in the art to fabricate such specific matching sub-circuits, as disclosed by Appellants, for use in Nishiyama.

Concerning the separate rejection of dependent claims 5 and the separate rejection of dependent claims 8 and 16, the Examiner has not established that the added references make up for the aforementioned deficiency in the Examiner's rejection over Nishiyama and Deguchi.

On this record, we are constrained to reverse all of the stated obviousness rejections.

CONCLUSION/ORDER

The Examiner's decision to reject claims 1, 3, 4, 6, 7, 9, 10, 12-15, and 17-21 under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi; to reject claim 5 under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi, and Goodman; and to reject claims 8 and 16 under 35 U.S.C. § 103(a) as being unpatentable over Nishiyama in view of Deguchi, and Suemasa is reversed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C. F. R. § 1.136(a).

REVERSED

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